

V. "Spectroscopic Notes.—No. I. On the Absorption of great Thicknesses of Metallic and Metalloidal Vapours." By J. NORMAN LOCKYER, F.R.S. Received April 20, 1874.

It has been assumed hitherto that a great *thickness* of a gas or vapour causes its radiation, and therefore its absorption, to assume more and more the character of a continuous spectrum as the thickness is increased.

It has been shown by Dr. Frankland and myself that such a condition obtains when the *density* of a vapour is increased, and my later researches have shown that it is brought about in two ways. Generalizing the work I have already done, without intending thereby to imply necessarily that the rule will hold universally, or that it exhausts all the phenomena, it may be stated that metallic elements of low specific gravity approach the continuous spectrum by widening their lines, while metallic elements of high specific gravity approach the continuous state by increasing the number of their lines. Hence in the vapours of Na, Ca, Al, and Mg we have a small number of lines which broaden, few short lines being added by increase of density; in Fe, Co, Ni, &c. we have many lines which do not so greatly broaden, many short lines being added.

The observations I made in India during the total solar eclipse of 1871 were against the assumption referred to; and if we are to hold that the lines, both "fundamental" and "short," which we get in a spectrum, are due to atomic impact (defining by the word atom, provisionally, that mass of matter which gives us a line-spectrum), then, as neither the quantity of the impacts nor the quality is necessarily altered by increasing the thickness of the stratum, the assumption seems also devoid of true theoretical foundation.

One thing is clear, that if the assumed continuous spectrum is ever reached by increased thickness, as by increased density, it must be reached through the "short-line" stage.

To test this point I have made the following experiments:—

1. An iron tube about 5 feet long was filled with dry hydrogen; pieces of sodium were carefully placed at intervals along the whole length of the tube, except close to the ends. The ends were closed with glass plates. The tube was placed in two gas-furnaces in line and heated. An electric lamp was placed at one end of the tube and a spectroscope at the other.

When the tube was red-hot and filled with sodium-vapour throughout, as nearly as possible, its whole length, a stream of hydrogen slowly passing through the tube, the line D was seen to be absorbed; it was no thicker than when seen under similar conditions in a test-tube, and far thinner than the line absorbed by sodium-vapour in a test-tube, if the density be only slightly increased.

Only the longest "fundamental" line was absorbed.

The line was thicker than the D line in the solar spectrum, in which spectrum all the short lines are reversed.

2. As it was difficult largely to increase either the temperature or the density of the sodium-vapour, I have made another series of experiments with iodine-vapour.

I have already pointed out the differences indicated by the spectro-scope between the quality of the vibrations of the "atom" of a metal and of the "subatom" of a metalloid (by which term I define that mass of matter which gives us a spectrum of channelled spaces, and builds up the continuous spectrum in its own way). Thus, in iodine, the short lines, brought about by increase of density in an atomic spectrum, are represented by the addition of a system of well-defined "beats" and broad bands of continuous absorption to the simplest spectrum, which is one exquisitely rhythmical, the intervals increasing from the blue to the red, and in which the beats are scarcely noticeable.

On increasing the density of a very small thickness by a gentle heating, the beats and bands are introduced, and, as the density is still further increased, the absorption becomes continuous throughout the whole of the visible spectrum.

The absorption of a thickness of 5 feet 6 inches of iodine-vapour at a temperature of 59° F. has given me no indication of bands, while the beats were so faint that they were scarcely visible.

VI. "Spectroscopic Notes.—No. II. On the Evidence of Variation in Molecular Structure." By J. NORMAN LOCKYER, F.R.S. Received May 26, 1874.

1. In an accompanying note I have shown that when different degrees of dissociating power are employed the spectral effects are different.

2. In the present note I propose to give a preliminary account of some researches which have led me to the conclusion that, starting with a mass of elemental matter, such mass of matter is continually broken up as the temperature (including in this term the action of electricity) is raised.

3. The evidence upon which I rely is furnished by the spectroscope in the region of the visible spectrum.

4. To begin by the extreme cases, all solids give us continuous spectra; all vapours produced by the high-tension spark give us line-spectra.

5. Now the continuous spectrum may be, and as a matter of fact is, observed in the case of chemical compounds, whereas all compounds known as such are resolved by the high-tension spark into their constituent elements. We have a right, therefore, to assume that an element in the solid state is a more complex mass than the element in a state of vapour, as its spectrum is the same as that of a mass which is known to be more complex.